

WHAT IS CLAIMED IS:

1. An optical device comprising:
 - a first-conductivity-type semiconductor substrate;
 - 5 a mesa stripe overlying said semiconductor substrate and including an active layer;
 - a layer structure formed on both side surfaces of said mesa stripe in contact therewith, said layer structure including a semi-insulating layer, a first-conductivity-type buried layer and a carrier-depleted layer consecutively formed as viewed from said semiconductor substrate; and
 - 10 a second-conductivity-type cladding layer formed on said top of said mesa stripe and said carrier-depleted layer.
- 15 2. The optical device according to claim 1, wherein said optical device is an optical modulator.
3. The optical device according to claim 2, wherein said active layer absorbs laser.
- 20 4. The optical device according to claim 3, wherein said active layer comprises InGaAsP- or InGaAlAs-based semiconductor material.
- 25 5. The optical device according to claim 3, wherein said active

layer has a multiple quantum well structure including Tl.

6. The optical device according to claim 3, wherein said semi-insulating film is either a Fe-doped or a Ru-doped InP layer, said
5 first-conductivity-type buried layer is an impurity-doped InP layer, and said carrier-depleted layer is an undoped InP layer.
7. The optical device according to claim 6, wherein said impurity-doped InP layer has a carrier density between $1 \times 10^{18} \text{ cm}^{-3}$ and $1 \times 10^{19} \text{ cm}^{-3}$.
8. The optical device according to claim 4, wherein said semi-insulating layer is a Fe-doped or Ru-doped InP layer, said first-conductivity-type buried layer is an impurity-doped InP layer, and
15 said carrier-depleted layer is a Fe-doped or Ru-doped InP layer.
9. The optical device according to claim 8, wherein said impurity-doped InP layer has a carrier density between $1 \times 10^{18} \text{ cm}^{-3}$ and $1 \times 10^{19} \text{ cm}^{-3}$.
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10. The optical device according to claim 1, wherein said carrier-depleted layer has a thickness of 0.1 to 0.5 μm .
11. The optical device according to claim 1, wherein said first-conductivity-type buried layer includes a first buried film and a
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second buried film overlying said first buried film, said first buried film has a top semiconductor surface extending from a top of each side surface of said mesa stripe between a (111) B-plane or (11x) B-plane where $x \geq 2$, and at least an edge portion of said second buried film resides within $0.3\mu\text{m}$ from said top of said each side surface of said mesa stripe.

12. The optical device according to claim 11, wherein said semiconductor substrate comprises III-V group compound semiconductor material and has a (100) plane, said mesa stripe extending on said (100) plane in a [011] orientation.

13. The optical device according to claim 1, further comprising a diffusion suppression layer between said mesa stripe and said first-conductivity-type buried layer.

14. The optical device according to claim 13, wherein said diffusion suppression layer has a thickness of 0.005 to $0.3\mu\text{m}$.

20 15. The optical device according to claim 13, wherein each of said layers comprises an InP-based semiconductor material, said first conductivity type is an n-type, said second conductivity type is a p-type, and said diffusion suppression layer includes at least one of a Fe-doped InP layer, a Ru-doped InP layer, an n-type InP
25 layer and an undoped InP layer.

16. The optical device according to claim 15, wherein said diffusion suppression layer includes an n-type InP layer, and said n-type InP layer is in a spaced relationship with said side surface
5 of said mesa stripe.
17. The optical device according to claim 16, wherein said diffusion suppression layer includes an n-type InP layer, said n-type InP layer having an impurity concentration between $1 \times 10^{16} \text{ cm}^{-3}$ and $5 \times 10^{18} \text{ cm}^{-3}$.
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18. The optical device according to claim 16, wherein said diffusion suppression layer includes a Fe-doped or Ru-doped InP layer, said Fe-doped or Ru-doped InP layer has an impurity
15 concentration between $1 \times 10^{16} \text{ cm}^{-3}$ and $1 \times 10^{17} \text{ cm}^{-3}$.
19. An optical integrated device comprising the optical device according to any one of claims 1 to 18, and a distributed feedback (DFB) laser diode, which are integrated on said first-conductivity-type semiconductor substrate in a monolithic structure.
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20. A method for manufacturing an optical modulator, comprising the steps of:
forming a mesa stripe overlying a first-conductivity-type
25 semiconductor substrate and including an active layer;

forming consecutively a semi-insulating film, a first-conductivity-type buried layer, and a carrier-depleted layer, which are buried on both side surfaces of said mesa stripe; and

5 forming a second-conductivity-type cladding layer on top of said mesa stripe and said carrier-depleted layer, wherein:

said first-conductivity-type buried layer is grown on a first growth rate when a plane orientation of said first first-conductivity-type buried layer extending from a top of said side surface of said mesa stripe resides between a (111) B-plane and a 10 (11x) B-plane, and grown on a second growth rate larger than said first growth rate after said plane orientation reaches a (11x) plane where $x \geq 2$.